High harmonic generation as a probe of the structure and dynamics of molecules and solid materials

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High harmonic generation is rapidly becoming a useable tool for probing the structure and dynamics of molecules and solid materials. In this talk, I present recent results from the Artemis facility for ultrafast XUV science at the UK's Central Laser Facility.

When harmonics are generated from molecules, the spectrum can contain information on both nuclear structure and electron dynamics. Using longer wavelength drive radiation (1300 nm) extends the harmonic spectrum to higher photon energies for the same laser intensity, and this has enabled us to observe structural and dynamical information from more complex molecules. However, using a longer wavelength drive laser strongly reduces the efficiency of harmonic generation. We have recently found that using multiple drive wavelengths, the conversion efficiency can be increased by up to two orders of magnitude.

While the experiments on molecular structure rely on a whole comb of harmonics being observed, many experiments require a single wavelength as using a comb both modifies the interaction and makes measuring electron spectra difficult. We have used a novel monochromator designed to select a single harmonic from a spectrum without stretching the pulse to study both atomic ionization and time-and-angle resolved photoemission from solid materials.